CLAIMS

We claim:

1) A micromechanical device having at least a portion comprising a nitride compound and a late transition metal.

2) The micromechanical device of claim 1, wherein the nitride compound is a nitride of silicon, boron or aluminum.

3) The micromechanical device of claim 2, wherein the nitride compound is a silicon nitride or boron nitride.

4) The micromechanical device of claim 1, wherein the late transition metal is selected from the groups 8B or 1B of the periodic table.

5) The micromechanical device of claim 1, wherein the late transition metal is a ferromagnetic metal.

6) The micromechanical device of claim 1, which is a MEMS sensor or actuator.

7) The micromechanical device of claim 1, wherein the late transition metal is a noble metal.

8) The micromechanical device of claim 1, wherein the late transition metal is Co, Ni, Pd, Pt, Ag or Au.

9) The micromechanical device of claim 1, wherein the nitride comprises less than .1 at % oxygen.

10) The micromechanical device of claim 1, wherein the nitride is an oxynitride that comprises up to 10 at % oxygen.

11) The micromechanical device of claim 1, wherein at least a flexible portion comprises the nitride compound and the late transition metal.

12) The micromechanical device of claim 1, comprising a substrate, a movable element formed in or on the substrate and a hinge for allowing movement of the movable element relative to the substrate.

13) The micromechanical device of claim 12, wherein the substrate is a semiconductor or light transmissive substrate.

14) The micromechanical device of claim 12, wherein the movable element and/or the hinge are formed of the nitride compound and the late transition metal.

15) The micromechanical device of claim 14, further comprising posts or walls for connecting the movable element to the substrate via the hinge.

16) The micromechanical device of claim 12, wherein the hinge is a sputtered hinge.

17) The micromechanical device of claim 12, wherein the device is a micromirror device with said movable element having a reflective layer thereon or therein.

18) The micromechanical device of claim 12, which is a sensor.

19) The micromechanical device of claim 17, wherein the reflective layer comprises Al, Ti or Au.

20) The micromechanical device of claim 17, wherein the micromirror device is a light beam steering device.

21) The micromechanical device of claim 17, wherein the light beam steering device is within an optical switch.

22) The micromechanical device of claim 17, wherein the micromirror device is part of a micromirror array in a display.

23) The micromechanical device of claim 22, wherein the display is a direct view or projection display.

24) A micromechanical device selected from a micromirror, a MEMS switch and a MEMS sensor, having a movable portion and a flexible portion, wherein at least one of the movable portion and flexible portion comprise a ceramic compound and a late transition metal.

25) The micromechanical device of claim 24, wherein the ceramic compound and late transition metal are within the same film or layer.

26) The micromechanical device of claim 25, wherein the film or layer is a ternary or higher system deposited by chemical or physical vapor deposition.

27) A method of making a micromechanical device, comprising:

providing a substrate;

providing a sacrificial layer on the substrate;

providing a structural element on the sacrificial layer;

providing a flexible element for connecting the structural element directly or indirectly to the substrate, wherein the structural element and/or the flexible element of the MEMS device comprises a nitride compound and a late transition element; and

removing the sacrificial layer so that the structural element is free to move via the flexible element relative to the substrate.

28) The method of claim 27, wherein the substrate is a glass and/or silicon wafer.

29) The method of claim 28, wherein the sacrificial layer comprises silicon or an organic material.

30) The method of claim 28, wherein the MEMS device is a mirror element.

31) The method of claim 28, wherein the mirror element is deposited and patterned on a sacrificial amorphous silicon layer.

32) The method of claim 30, wherein the flexible element and/or structural element is sputtered, followed by etching.

33) The method of claim 30, wherein the MEMS device comprises a reflective and conductive portion.

34) The method of claim 27, wherein a plurality of individual flexible portions are formed.

35) The method of claim 27, wherein the hinge is formed by an ion beam or discharge directed at a target comprising a transition metal and Si, B or Al.

36) The method of claim 35, wherein the flexible element and/or structural element formation is in an atmosphere of a noble gas and nitrogen.

37) The method of claim 30,wherein the late transition metal is a noble metal.

38) The method of claim 30, wherein the late transition metal is a ferromagnetic metal.

39) The method of claim 38, wherein the MEMS device is a beam steering device in an optical switch.

40) The method of claim 38, wherein the structural element is a micromirror that is part of any array of micromirrors formed at the same time for an optical switch or a direct view or projection display.

41) The method of claim 27, wherein the hinge is nearly or fully saturated with nitrogen.

42) The method of claim 41, wherein the hinge comprises particles of late transition metals or late transition metal silicides or borides interspersed within the nitride compound.

43) The method of claim 42, wherein the dielectric is a nitride of silicon, boron or aluminum.

44) The method of claim 43, wherein the transition metal forms from 10 to 80 atomic percent of the material formed and the elements of the nitride compound each range from 20 to 65 atomic percent.

45) The method of claim 27, wherein the ultimate tensile yield strength of the material of the MEMS device is greater than 1 GPa.

46) The method of claim 27, wherein the mirror element is formed before, at the same time, or after, forming the hinge.

47) The method of claim 27, further comprising annealing the MEMS device before or after removing the sacrificial layer.

48) The method of claim 27, wherein the structural element and/or flexible element are reactively sputtered films formed by reactive sputtering in a nitrogen atmosphere.

49) The method of claim 48, wherein the sputtering is in from 10 to 90 % atmosphere.

50) The method of claim 27, wherein the structural and/or flexible elements have from 10 to 60 atomic % nitrogen.

51) The method of claim 50, wherein the structural and/or flexible elements are sputtered from a target comprised of from about 15 to 85% late transition metal and from about 85 to 15% silicon.

52) The method of claim 51, wherein the structural and/or flexible elements are sputtered from a target comprised of about 20 to 80% late transition metal and from about 80 to 20% silicon.

53) The method of claim 27, wherein the target comprises at least one late transition metal and at least one of silicon, boron, carbon, phosphorous and aluminum.

54) The method of claim 50, wherein the structural and/or flexible elements have a long range order of less than 100A.

55) A micromechanical device comprising a late transition metal formed by chemical or physical vapor deposition.

56) The micromechanical device of claim 55, wherein the late transition metal is selected from groups 8B or 1B of the periodic table.

57) The micromechanical device of claim 55, further comprising an element from groups 3A to 6A of the periodic table.

58) The micromechanical device of claim 57, comprising more than one element from groups 3A to 6A.

59) The micromechanical device of claim 58, comprising two or more elements from the first two rows of groups 3A to 6A.

60) The micromechanical device of claim 59, wherein one of the two or more elements is nitrogen.

61) The micromechanical device of claim 60, wherein another of the two or more elements is aluminum, boron, silicon carbon or oxygen.

62) The micromechanical device of claim 61, wherein the late transition metal is a ferromagnetic metal.

63) The micromechanical device of claim 106, wherein the late transition metal is a noble metal.

64) A micromechanical device comprising a ceramic compound and a late transition metal.

65) The micromechanical device of claim 64, wherein the ceramic compound is a nitride and/or oxide compound, and the late transition metal is selected from either of groups 8B or 1B in the periodic table.

66) The micromechanical device of claim 65, wherein the device comprises in at least one element from groups 8B or 1B and two or more elements from the first two rows of groups 3A to 6A of the periodic table.

67) The micromechanical device of claim 64, where the ceramic compound and late transition metal are a termary or higher system within a common layer.

68) A method for forming a micromechanical device, comprising:

providing a substrate;

depositing a sacrificial layer;

forming one or more additional layers which define the micromechanical device at least in part; and

removing the sacrificial layer;

wherein the one or more additional layers are formed by sputtering a target, the target having at least two elements, one being selected from groups 8B or 1B of the periodic table, and another being selected from groups 3A to 6A of the periodic table.

69) The method of claim 68, wherein the sputtering is reactive sputtering in an atmosphere of nitrogen and/or oxygen.

70) The method of claim 69, wherein the atmosphere is entirely or almost entirely nitrogen.